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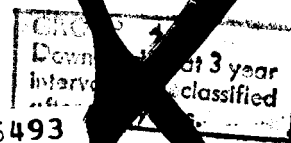
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CONTROL WEIGHTS REQUIREMENTS (U)

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**NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
WASHINGTON, D. C. 20546**

FOREWORD

This document has been developed to provide the basis for weight compatibility of the launch vehicle and spacecraft by establishing control values for both vehicle weights and payload capabilities.

The necessary steps should be taken to ensure that the requirements of this document are met in the Apollo Program.



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INTRODUCTION

This document establishes official Control Weights for the Saturn IB and Saturn V launch vehicles and Apollo Spacecraft. The Interim Control and Design Goal Weights directive MD-E 8000.004 and all other previously used Apollo Control Weights are superseded by this document.

Proposed changes to this document shall be submitted to MSF for review and coordination. The Apollo Control Weights document will be revised, as required, to reflect approved changes.

After this document is incorporated into the Apollo Program Specifications, changes will be transmitted in accordance with the Apollo Configuration Management Manual.

DISCUSSION OF CONTROL WEIGHTS

The Control Weights presented in this document are established to insure that the spacecraft's weight and the launch vehicle's payload capability are compatible and to insure that each Apollo flight mission, as presented in the Apollo Flight Mission Assignments directive M-DE 8000.005C, can be achieved.

It is the responsibility of the Centers to control all design activities to insure that the Control Weights are not violated.

Pages 5 and 6 present sets of Control Weights for the Saturn IB and Saturn V launch vehicles. The Control Weights are listed separately for the early vehicles and as a group for the operational vehicles. Pages 10 and 11 present Control Weights for the Apollo Spacecraft according to mission type.

DEFINITION OF TERMS

Control Point:	Any designated portion of a space vehicle for which Control Weights are specified in this document.
Control Weight:	<p>The limiting value of weight, capacity or capability of a control point based on a specified mission.</p> <p>The established weights shall not be exceeded and the established tank capacity and payload capability shall be guaranteed values.</p>
Dry Weight:	<p>The weight of hardware not including fluids except those of sealed closed-loop systems which are installed as single complete items. This weight is the sum of <u>Mass Properties Standard M-DE 8000.006</u> Functional Code items 1 through 16 or equivalent.</p>
Payload Capability:	<p>The guaranteed payload (spacecraft injected weight) that the launch vehicle will carry as specified under "Launch Vehicle Payload Requirements", page 7.</p>
Injected Inert Weight:	<p>The spacecraft module's weight at the time of spacecraft separation from the launch vehicle, excluding usable propellant.</p>

Injection Weight: The weight of a launch vehicle stage at the time of placing the spacecraft on the desired trajectory.

Propellant Tank Capacity: The design mainstage propellants, i.e., the amount of usable propellants for which stage or module propellant tanks are sized.

Separation Weight: The weight of an expended launch vehicle stage as it separates from a flight stage.

Usable Propellants: The propellants loaded for a specified mission for providing velocity changes. Mass Properties Standard M-DE 8000.006 Functional Code number 23 or equivalent.

SATURN IB CONTROL WEIGHTS

CONTROL POINT	ITEM	CONTROL WEIGHT (lbs.)				
		201	202	203	204	205 to 212
S-IB	DRY WEIGHT	94,700	94,700	89,200	89,000	88,600
	PROPELLANT TANK CAPACITY	883,000	883,000	883,000	883,000	883,000
	SEPARATION WEIGHT	106,500	106,500	100,700	100,500	100,100
S-IB/S-IVB INTERSTAGE	TOTAL WEIGHT	7,000	7,000	7,000	7,000	7,000
S-IVB	DRY WEIGHT	25,050	25,050	24,110	24,010	23,510
	PROPELLANT TANK CAPACITY	230,000	230,000	230,000	230,000	230,000
	INJECTION WEIGHT.	27,294	27,294	26,171	26,077	25,569
INSTRUMENT UNIT	TOTAL WEIGHT	4,650	4,650	4,650	4,650	4,150
LAUNCH VEHICLE	PAYLOAD CAPABILITY NOTE 1	39,500	NOTE 2	32,000	32,500	35,500

DATE 8/24/64

NOTE 1 All payload capabilities are based on the Launch Vehicle Payload Requirements as shown on page 7.

NOTE 2 Under Study

SATURN V CONTROL WEIGHTS

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CONTROL POINT	ITEM	CONTROL WEIGHT (lbs.)					
		501	502	503	504 NOTE 2	505 NOTE 2	506 to 515
S-IC	DRY WEIGHT	312,500	312,500	312,500	304,500	304,500	300,000
	PROPELLANT TANK CAPACITY	4,400,000	4,400,000	4,400,000	4,400,000	4,400,000	4,400,000
	SEPARATION WEIGHT	381,518	381,518	381,518	373,518	373,518	369,018
S-IC/S-II INTERSTAGE	TOTAL WEIGHT	14,200	14,200	14,200	14,100	14,100	14,100
S-II	DRY WEIGHT	86,000	86,000	86,000	83,600	83,600	81,900
	PROPELLANT TANK CAPACITY	930,000	930,000	930,000	930,000	930,000	930,000
	SEPARATION WEIGHT	96,259	96,259	96,259	93,839	93,839	92,139
S-II/S-IVB INTERSTAGE	TOTAL WEIGHT	7,700	7,700	7,700	7,700	7,700	7,700
S-IVB	DRY WEIGHT	28,200	28,200	28,200	28,100	28,100	27,400
	PROPELLANT TANK CAPACITY	230,000	230,000	230,000	230,000	230,000	230,000
	INJECTION WEIGHT	30,491	30,491	30,491	30,391	30,391	29,691
INSTRUMENT UNIT	TOTAL WEIGHT	4,650	4,650	4,650	4,650	4,650	4,150
LAUNCH VEHICLE	PAYLOAD CAPABILITY NOTE 1	85,000	85,000	85,000	93,000	93,000	95,000

DATE 8/24/64

NOTE 1 All payload capabilities are based on the Launch Vehicle Payload Requirements as shown on page 7.

NOTE 2 The payload capability of vehicles 504 and 505 are 2000 lbs. less than that of operational vehicles because of removable R&D instrumentation.

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LAUNCH VEHICLE PAYLOAD REQUIREMENTS

The Saturn IB Launch Vehicle shall:

A. Vehicle number 201

1. Be capable of placing a spacecraft (CSM and adapter) of 39,500 lbs. gross weight on a trajectory with a total energy of $-4.0 \times 10^8 \text{ Ft}^2/\text{sec}^2$, angular momentum of $4.7 \times 10^{11} \text{ Ft}^2/\text{sec}$ and with S-IVB cutoff occurring during ascending flight at an altitude between 900,000 and 1,100,000 ft.
2. Be capable of meeting the requirements of 1 (above) under the conditions of the specified mission including:
 - (a) carrying the Control Weight LES until jettisoned and
 - (b) orienting and stabilizing the spacecraft at its proper attitude (to within S-IVB attitude control deadband accuracy) prior to S-IVB/CSM separation.

B. Vehicle number 202

1. Be capable of placing a spacecraft (CSM and adapter) of _____pounds gross weight on a trajectory (to be defined) which is appropriate for the heat shield entry test objectives and consistent with other test objectives.

2. Be capable of meeting the requirement 1 (above) under the conditions of the specified mission including carrying the Control Weight LES until jettisoned.

C. Vehicles number 203 through 212

1. Be capable of injecting the guaranteed payload into a 105 nautical mile circular earth orbit;
2. Be capable of meeting the requirement of 1 (above) under the conditions of the specified mission including carrying the Control Weight LES until jettisoned and stabilizing in earth orbit.

The Saturn V Launch Vehicle shall:

1. Be capable of injecting the guaranteed payload into a translunar trajectory of total energy - $8.05 \times 10^6 \text{ ft}^2/\text{sec}^2$ (a nominal 72 hour translunar trajectory with the moon at the mean earth-moon distance);
2. Have performance capability in addition to that required by 1 (above) of 260 fps to accommodate:
 - a. any free return trajectory, and
 - b. earth orbit injection on either of two alternative orbits;
3. Be capable of meeting the requirements of 1 and 2 (above) under the conditions of the lunar mission including:

(a) carrying the Control Weight LES until jettisoned,
(b) the extremes of launch azimuth, (c) maneuvering in
earth orbit and (d) stabilizing during transportation and
dock.

APOLLO SPACECRAFT CONTROL WEIGHTS WEIGHTS SATURN IB MISSIONS

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CONTROL POINT	ITEM		CONTROL WEIGHT (lbs)			
			LV-CSM DEVELOPMENT		CSM LONG DURATION OPERATIONS	CSM-LEM OPERATIONS
	SPACECRAFT NUMBER	CSM	009	011 014 012 015	012 015 014	1 2 3 4 5
		LEM				
COMMAND MODULE (WITH CREW)	TOTAL WEIGHT		9,500	11,000 UNMANNED	11,000	11,000 NOTE 2
SERVICE MODULE	DRY WEIGHT PROPELLANT TANK CAPACITY INJECTED INERT WEIGHT USABLE PROPELLANT		TO BE DETERMINED 45,000 45,000 9,200 10,200 16,900 NOTE 1		45,000 10,200 6,900	TO BE DETERMINED 41,000 9,285 2,000
LEM ASCENT STAGE (NO CREW)	DRY WEIGHT PROPELLANT TANK CAPACITY MAIN TANKS RCS TANKS INJECTED INERT WEIGHT USABLE PROPELLANT					TO BE DETERMINED 4,922 330 4,825 500
LEM DESCENT STAGE	DRY WEIGHT PROPELLANT TANK CAPACITY INJECTED INERT WEIGHT USABLE PROPELLANT					TO BE DETERMINED 15,920 3,590 500
ADAPTER	TOTAL WEIGHT NOTE 3		3,900	3,900	3,900	3,900
LAUNCH ESCAPE SYSTEM	TOTAL WEIGHT		8,200	8,200	8,200	8,200
SPACECRAFT	LIFT-OFF WEIGHT INJECTED WEIGHT		47,700 39,500	NOTE 1	40,200 32,000	43,700 35,500

DATE 8/24/64

NOTE 1: UNDER STUDY
NOTE 2: THE USE OF A BLOCK 1 CSM FOR THIS MISSION IS UNDER STUDY
NOTE 3: THE ADAPTER WEIGHT FOR MISSIONS WITHOUT LENS IS 100 POUNDS
HEAVIER DUE TO STRUCTURAL MEMBER TO REPLACE LEM

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APOLLO SPACECRAFT CONTROL WEIGHTS SATURN V MISSIONS

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CONTROL POINT	ITEM	CONTROL WEIGHT (lbs)		
		LV AND HEATSHIELD DEVELOPMENT	LUNAR MISSIONS & SIMULATIONS	
	SPACECRAFT NUMBER	CSM		
		LEM	3 THRU 14	
COMMAND MODULE (WITH CREW)	TOTAL WEIGHT	11,000	11,000	11,000
SERVICE MODULE	DRY WEIGHT	TO BE DETERMINED		
	PROPELLANT TANK CAPACITY	41,000 NOTE 2		
	INJECTED INERT WEIGHT	10,200		
	USABLE PROPELLANT	38,510		
LEM ASCENT STAGE (NO CREW)	DRY WEIGHT	TO BE DETERMINED		
	PROPELLANT TANK CAPACITY	4,922		
	MAIN TANKS	330		
	RCS TANKS	4,650		
	INJECTED INERT WEIGHT	4,325		
	USABLE PROPELLANT	5,085		
LEM DESCENT STAGE	DRY WEIGHT	TO BE DETERMINED		
	PROPELLANT TANK CAPACITY	15,920		
	INJECTED INERT WEIGHT	3,865		
	USABLE PROPELLANT	8,650		
ADAPTER	TOTAL WEIGHT	3,800	3,800	3,800
LAUNCH ESCAPE SYSTEM	TOTAL WEIGHT	8,200	8,200	8,200
SPACECRAFT	LIFT-OFF WEIGHT	93,200	93,200	102,210
	INJECTED WEIGHT	85,000	85,000	93,010
				NOTE 1

NOTE 1: THE ALLOWABLE VALUE OF INJECTED WEIGHT FOR THIS MISSION IS 94,000 POUNDS DATE 8/24
EXCEPT FOR THE FIRST TWO FLIGHTS FOR WHICH THE VALUE IS LIMITED TO 93,000
POUNDS DUE TO RED INSTRUMENTATION IN THE LAUNCH VEHICLES.

NOTE 2: THE CSM WEIGHTS SHOWN ARE FOR BOTH BLOCK I AND II SPACECRAFT EXCEPT FOR
PROPELLANT TANK CAPACITY. FOR BLOCK I CSM THE PROPELLANT TANK CAPACITY
IS 45,000 POUNDS.

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REFERENCE DOCUMENTS

- M-DE 8000.006 Directive, Mass Properties Standard, Office of
Manned Space Flight, June 1, 1963.
- M-DE 8000.005C Directive, Apollo Flight Mission Assignments,
Manned Space Flight, July 21, 1964.